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ORIGINAL ARTICLE

Evaluation of the Clinical Application of Multi-Color Optical Coherence Tomography as a Diagnostic Tool for Different Retinal Pathologies

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ABSTRACT

Objective: To assess clinical application of multi-color OCT (Optical Coherence Tomography) with the utilization of the CSLO (Confocal Scanning Laser-Ophthalmoscopy) in various pathologies of retina.

Methodology: This study was conducted at in Benazir Bhutto Shaheed Teaching Hospital Abbottabad and the duration of this study was from April 2021 to June 2021. There were thirty-six patients in this research study who were suffering from various retinal pathologies as disorders of vitreomacular interface, diabetic retinopathy and macular degeneration related with age with the utilization of multi-color OCT as a tool of screening.

Results: This study discovered that ophthalmologist were able to get high resolution images of CSLO reflectance because of the automatic tracking system of this particular tool (new version). Confocal optics may be used to avoid the scattering of light. Some of the differences were presence of hemorrhages and presences of pigment changes when comparison with the conventional CFP was performed. Approximately 20.0% patients with AMD, 37.50% patients with diabetes and 100% patients suffering from disorders of vitreomacular interface could have been missed easily with the utilization of CFP.

Conclusions: The findings conclude that multi-color OCT is able to deliver information & figures far more confident was compared to conventional method of CFP, because it is much influenced by the media opacities. For the best interpretation of the Multi-color OCT, more watchfulness of the ophthalmologists is necessary with high level of comprehensiveness.

Keywords: Retinal Pathologies, Multi-Color, Diabetic Retinopathy, Optical Coherence Tomography.

INTRODUCTION

The invention of the imaging Techniques in current century has unlocked new paths for the ophthalmologists to detect and diagnose various complications of eye, especially retina and handle these complications more professionally. The availability of digital Imaging in comparison with the past film-based cinematography has changed the current practices in ophthalmology in CFP, OCT and FA (Fundus angiography) [1]. These advancements have made it possible to have accurate records for the patients who are suffering from different retinal pathologies. High quality images are helpful for the professionals to make correct guidance and prompt decisions [2]. There are many advantages of this modality as 3-dimensional exploration, less follow up of patients and direct comparison with the previous records of the complication [3]. In 1800s, the main imaging modality was CFP and it emerged as best tool to get the pictures of macula, optic disc and peripheral retina.

Modern technology constructed the camera with microscope attached with it for high level resolution. The advancements as stereoscopic imaging, digital imaging and non-mydriatic functions have made its use much widespread [4]. There are some restrictions for the computerized analysis as inconsistency of the fundus pigmentation resolution of narrow range and non-favorable media opacities [5]. The invention of SLO (Scanning Laser Ophthalmoscope) took place in 1980s which made the ophthalmologists able with a substitute procedure for taking the images of fundus [6]. CSLO system has the ability to provide the high resolution. In addition, we can get all the images in real time. Some of the important drawbacks of SLO are tainted information due to movements of eyes during testing and reflections from cornea [7]. OCT is the best modality which utilizes the coherent light for the capturing of 2 and 3-dimensional images. Multi-color code was developed by the Heidelberg which utilized CSLO technology with some important changes.

The main reason of utilizing 3 wavelengths is to practice their penetrating properties at different lengths of retina. Blue Reflectance =BR: 488.0nmshows the inner retina as well as vitreoretinal interface. Green Reflectance = GR: 518.0nm allows much deep penetration and make the visibility of blood vessels of retina possible. Infrared Reflectance = IR: 820.0nmchecks the alterations in outer layer of retina [8,9].

MATERIAL AND METHODS

This study was conducted at in Benazir Bhutto Shaheed Teaching Hospital Abbottabad and the duration of this study was from April 2021 to June 2021. There were thirty-six patients in this research work who were suffering from various pathologies of retina. In this research work, we utilized a different modality of multi-color OCT to perform screening of various ocular pathologies like DR (Diabetic Retinopathy), AMD (Age-related Macular Degeneration), and disorders of vitreomacular interface and various impacts of these complications on retina as well as macula and this also states the diverse retinal irregularities due to changing in the wavelengths. We got the permission of the Ethical Committee for the conduction of this research work. We included total thirty-six patients from the range of age from 40 to 60 years. There were twelve patients of each

disease as mentioned above. We got the written consent from all the patients after explaining them the objective of this research study.

We used a typical fundus camera Nikon-D700 made of Japan for the capturing of CFP (Color Fundus Photograph) after dilatating the eyes with the use of eye drops tropicamide 1.0%. Field view was at 30° to 40°, which was positioned on macula. We used the Spectral is OCT for performing the high speed combined as well as simultaneous CSLO and SD-OCT (Spectral Domain OCT) imaging including the multi-color and 70.0kHz OCT module device with the utilization of multi-color mode on a region of the central 30.0° &55.0°. The acquisition of image included the BR {blue reflectance: (λ = 488.0nm)}, near IR {infrared reflectance:(λ = 820.0nm)} and GR {green reflectance: (λ = 518.0nm)}.

RESULTS

We took the images of the patients who appeared with DR, AMD and disorders of vitreomacular interface. The average age of the patients was 48.60 years in all 3 groups. Female patients were mostly affected with AMD and male patients were more suffering from DR and vitreomacular complications. There is better appreciation of the retinal imaging for these three pathologies and their visualization is carried out with multi-color OCT.

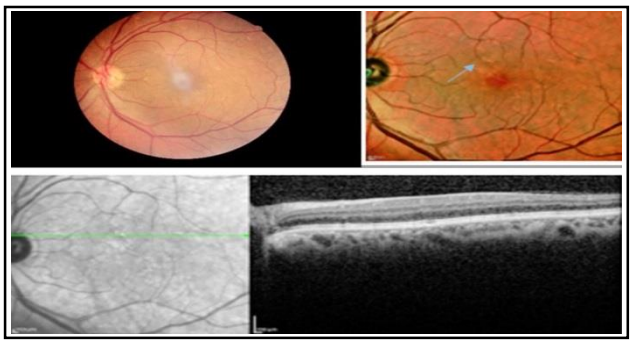

Fig 1:

Age-Related Macular Degeneration: Most common application of multi-color OCT is in AMD which allows the ophthalmologists to detect it in initial stage and keep it under consideration in the duration of anti VEGF treatment. With the help of multi-color OCT, there is more distinct imaging and detection of the reticular pseudo-drusen in comparison with the CFP [10]. There is also more clear demarcation of the GA (Geographic Atrophy) borders on multi-color images as compared to CFP [11]. During the period of this research study, twelve patients with less vision came to the retinal clinic of the hospital. There were four males and eight female patients. Among these twelve patients, three females were present with the known systematic diseases, so there were not included in the research study. Other nine patients underwent the standard procedure of screening; 5 patients showed the signs of AMD as unilaterally and 4 patients were present with bilateral disease. The investigation of the patients who were present with unilateral involvement, was carried out with the help of both multi-color OCT and CFP. There was increased visualization of only one (20.0%) eye on multi-color OCT as compared to CFP.

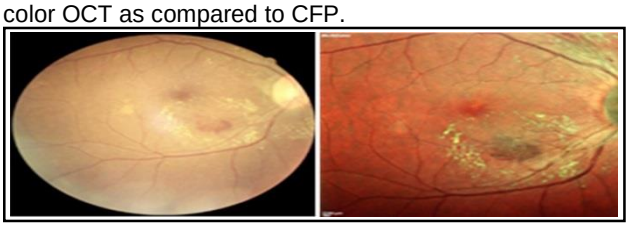

Fig 2:

Diabetic Retinopathy: In time screening and detection of DR is beneficial for the patients as well as their families. Multi-color images from the facilities of CSLO plus SD-OCT platform are much time saving and cost-effective [12, 13]. Twelve patients with known diabetes from last three and half years came for the regular follow up examination under fundoscopy. Five patients were from female gender and remaining patients were males. Three females and one male patient were suffering from bilateral diabetic retinopathy and other eight patients were present with non-proliferative diabetic alteration in one eye of very mild nature but the other eye of those patients was without any abnormality. The investigation of these patients was carried out with multi-color OCT and CFP. Out of total eight patients, 37.50% (n: 3) patients were available with early diabetic alterations which were obvious by multi-color OCT only.

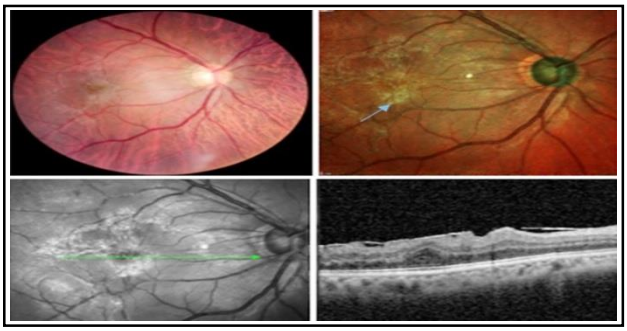

Fig 3:

Vitreomacular interface Disorders: The advancement of the multi-color OCT has made the identification of the vitreomacular traction much easy for the professionals in comparison with procedure of conventional method of CFP. Total 12 patients visited the hospital with complaints of distortion and blurring. Three patients were females and remining nine patients were males. Among them three females were present with vitreomacular traction with diabetics. 2 patients (males)were present with not complete posterior vitreous detachment. Seven male patients were present with no visible clinical symptom of any such complication. All these 7 patients underwent muti-color OCT and CFP and all these patients appeared with Grade 0 ERM (Epiretinal Membrane).

DISCUSSION

High grade fundus-imaging is very helpful for the screening, credentials and management of the different retinal diseases. Multi-color mode in the combine platform

of CSLO plus SD-OCT has eliminate the requirement of the color fundus cameras or any other related uses. This particular setup has the benefit to get multi-modal images like infrared imaging, fundus auto-fluorescence, SD-OCT and fluorescein [1,2,14]. In smaller setups of ophthalmology where space and cost restrictions permit much limited facilities, this tool of screening is very useful and it has the advantage of much time saving with high rate of turnover of patients [15].

Multi-color image is comprised of 3 images of reflectance which can be investigated distinctly to make the ophthalmologist able to interrogate the various retina layers and detect the pathologies related with the structure [16]. Muftuoglu in his research work stated that 56.20% ERM was much better visualized with the utilization of the multi-color imaging in comparison with the conventional method of CFP [17]. Same outcomes in favor of the multi-color OCT in the ERM detection was also elaborated by Reznicek [18]. One other research work performed by Ben Moussa stated that multi-color OCT is the best tool for the measurement of the geographic atrophy [19]. Graham in his research work conducted in 2017 also stated the results in collaboration of the multi-color imaging in identification of the pigment clumping (69.70%) to greater than 80.0% uncovering of the atrophic patches of AMD [20]. Ahmed in his research study on the multi-color imaging for the detection of DR described advantages of the use of this new modality [21].

CONCLUSION

There are many applications of multi-color imaging and it is possible to replace the conventional CFP with the multi-color imaging. There is extensive utilization of multi-color imaging in current times, so there is need of further research studies for the authentication of the retinal comprehension on multi-color imaging providing its comparison with the conventional CFP.

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